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<p>(71) Applicant: KIMBERLY-CLARK WORLDWIDE, INC. [US/US]; 401 North Lake Street, Neenah, WI 54956 (US). (72) Inventor: SCHIFFER, Daniel, Kenneth; 3608 Tallwood Court, Marietta, GA 30062 (US). (74) Agent: BRINKS, Henry, L.; Brinks Hofer Gilson &amp; Lione, NBC Tower, Suite 3600, 455 North Cityfront Plaza Drive, Chicago, IL 60611-5599 (US).</p>		<p>Published <i>With international search report.</i></p>	
<p>(54) Title: LIMITED USE PRODUCTS WITH ELASTIC BREATHABLE FILM PREPARED BY PHASE SEPARATION OF AN ELASTIC BASE RESIN</p>			
<p>(57) Abstract</p> <p>The present invention relates to a limited use product with an elastic breathable film as a barrier layer. The elastic breathable film is produced from phase-separation of an elastomeric resin. A method of producing the limited use product is also described.</p>			

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**LIMITED USE PRODUCTS WITH  
ELASTIC BREATHABLE FILM  
PREPARED BY PHASE SEPARATION  
OF AN ELASTIC BASE RESIN**

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**FIELD OF INVENTION**

The present invention is directed to breathable elastomeric films prepared by phase-separating a polyolefin film.

10

**BACKGROUND OF THE INVENTION**

The present invention is directed to breathable elastomeric films. Such materials have a wide variety of uses, especially in the areas of limited use and disposable 15 items.

Films have been traditionally used to provide barrier properties in limited use or disposable items. By limited use or disposable, it is meant that the product and/or component is used only a small number of times or possibly only once 20 before being discarded. Examples of such products include, but are not limited to, surgical and health care related products such as surgical drapes and gowns, disposable work wear such as coveralls and lab coats and personal care absorbent products such as diapers, training pants, 25 incontinence garments, sanitary napkins, bandages, wipes and the like. In personal care absorbent products such as infant diapers and adult incontinence products, films are used as the outer covers with the purpose of preventing body wastes from contaminating the clothing, bedding and other aspects of the 30 surrounding environment of use. In the area of protective apparel including hospital gowns, films are used to prevent cross exchange of microorganisms between the wearer and the patient.

While these films can be effective barriers, they are not 35 aesthetically pleasing because their surfaces are smooth and either feel slick or tacky. They are also visually flat and "plasty" thereby making them less desirable in apparel applications and other uses where they are in contact with human skin. It would be more preferable if these items were

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more cloth-like from both a tactile and visual standpoint. For example, infant diapers that have the feel and appearance of traditional cloth undergarments are perceived as premium products and may, in some cases, overcome the tendency to believe that they need to be covered by outer garments for aesthetic reasons. Garment-like adult incontinence products could improve the self image of the incontinent individual. In addition, more garment-like isolation gowns would help the hospital environment feel less foreign and threatening to the patient and increase the comfort of the wearer. It is also preferable to have films that can make an outercover material with more elastic give and recovery to provide better fit and comfort.

Lamination of films have been used to create materials which are both impervious and somewhat cloth-like in appearance and texture. The outer covers on disposable diapers are but one example. In this regard, reference may be had to coassigned U.S. Patent 4,818,600 dated April 4, 1989 and U.S. Patent 4,725,473 dated February 16, 1988. Surgical gowns and drapes are other examples. See, in this regard, coassigned U.S. Patent 4,379,102 dated April 5, 1983.

A primary purpose of the film in such laminations is to provide barrier properties. There is also a need for such laminates to be breathable so that they have the ability to transmit moisture vapor. Apparel made from laminations of these breathable or microporous films are more comfortable to wear by reducing the moisture vapor concentration and the consequent skin hydration underneath the apparel item.

There is therefore a need for an elastic breathable film and process that provides a film with both the cloth-like aesthetics and the fit and comfort that are desired.

The preparation of microporous membranes by phase separation of ethylene-based resins has been taught by U.S. Patent Nos. 4,778,601 and 4,828,772, both assigned to Millipore Corporation. The preparation of microporous membranes by phase separation of a polypropylene has been taught by U.S. Patent No. 4,874,567 also assigned to Millipore. Additionally, the preparation of microporous

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membranes by phase separation of fluorocarbons has been taught by U.S. Patent Nos. 4,902,456; 4,906,377; 4,990,294; and 5,032,274, all assigned to Millipore Corporation. These patents teach the preparation of microporous or open

5 ultrafiltration membranes using rigid polymers such as ultra-high molecular weight polyethylene (UHMWPE) or fluorocarbons such as poly (tetrafluorethylene-co-perfluoro (alkyl vinyl ether))(PFA) or poly(tetrafluoroethylene-co-hexafluoropropylene) (FEP). However, these patents do not

10 suggest the formation of an elastic material by use of an elastic base resin or of a flexible polyolefin (FPO) such as a polypropylene with atactic groups in the polymer chain

SUMMARY OF THE INVENTION

15 The present invention relates a process for preparing a breathable elastic film or laminate and the products with films made by the process. In the process of the present invention a mixture is formed comprising an elastomeric resin and a solvent that permits solid (crystalline)-liquid phase separation, wherein between about 5 and about 50 weight percent of the mixture is the resin based upon the weight of the mixture. The mixture is heated to an elevated temperature to produce a solution of resin and solvent. A precursor film is then formed from the solution. The precursor film is cooled to effect phase separation of the elastomer from the solvent.

20 The solvent is then separated from the elastomer by extraction and the resultant film is then dried under restraint in order to minimize or prevent film shrinkage or collapse. In addition, the present invention provides laminate products

25 wherein a microporous and breathable elastic film produced by the process of this invention is bonded to a substrate on one or both surfaces of the film.

30

In one embodiment of the present invention, the resin material is selected from ethylene copolymers such as 35 metallocene-catalyzed ethylene-based polymers, polypropylene with atactic groups in the polymer chain and combinations thereof. For certain applications of the present invention, the breathable film has an immediate recovery length that is

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at least about 50% of its elongation following a stretch cycling that achieved a stretched length of about 150% of the unbiased length. In yet other applications, the film of the present invention may have an immediate recovery length that 5 is at least about 50% its elongation length following a stretch cycling that achieved a stretched length of about 200% of the unbiased length.

The process of the invention is applicable to films formed by various processes, i.e., cast or blown films.

10 The preferred film of the present invention has a water vapor transmission rate of from about 300 to about 4,500 grams per square meter per 24 hours (measured by ASTM Standard Test E 96-80 with Celgard® 2500 as control).

15 Such films and laminates have a wide variety of uses including, but not limited to, applications in personal care absorbent articles including diapers, training pants, sanitary napkins, incontinence devices, bandages and the like. These same films also may be used in items such as surgical drapes and gowns as well as various articles of clothing either as 20 the entire article or simply as a component thereof.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic side view of a process for forming a laminate according to the present invention.

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#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is directed to breathable elastic films prepared by phase-separating an polyolefin resin.

30 Useful polyolefin resins of the present invention are elastic. The term "elastic" is used herein to mean any material which, upon application of a biasing force, is stretchable, that is, elongatable, to a stretched, biased length which is at least about 150 percent of its relaxed 35 unbiased length, and which will recover at least 50 percent of its elongation upon release of the stretching, elongating force. A hypothetical example would be a one (1) inch sample of a material which is elongatable to at least 1.50 inches and

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which, upon being elongated to 1.50 inches and released, will recover to a length of not more than 1.25 inches. Many elastic materials may be stretched by much more than 50 percent of their relaxed length, for example, 100 percent or 5 more, and many of these will recover to substantially their original relaxed length, for example, to within 105 percent of their original relaxed length, upon release of the stretching force.

As used herein, the term "nonelastic" refers to any 10 material which does not fall within the definition of "elastic," above.

Examples of elastic polyolefins include polyethylene elastomers, elastic polymers such as flexible polyolefins ("FPOs") and combinations thereof.

15 One type of polyethylene elastomers is a metallocene catalyzed ethylene-based elastomer. The term "metallocene-catalyzed elastomers" as used herein includes those polymer materials that are produced by the polymerization of at least ethylene using metallocenes or constrained geometry catalysts, 20 a class of organometallic complexes, as catalysts. For example, a common metallocene is ferrocene, a complex with a metal sandwiched between two cyclopentadienyl (Cp) ligands. Metallocene process catalysts include bis(n-butylcyclopentadienyl)titanium dichloride, bis(n-butylcyclopentadienyl)zirconium dichloride, 25 bis(cyclopentadienyl)scandium chloride, bis(indenyl)zirconium dichloride, bis(methylcyclopentadienyl)titanium dichloride, bis(methylcyclopentadienyl)zirconium dichloride, cobaltocene, cyclopentadienyltitanium trichloride, ferrocene, hafnocene 30 dichloride, isopropyl(cyclopentadienyl,-1-flourenyl)zirconium dichloride, molybdocene dichloride, nickelocene, niobocene dichloride, ruthenocene, titanocene dichloride, zirconocene chloride hydride, zirconocene dichloride, among others. A more exhaustive list of such compounds is included in U.S. Patent 35 5,374,696 to Rosen et al. and assigned to the Dow Chemical Company. Such compounds are also discussed in U.S. Patent 5,064,802 to Stevens et al. and also assigned to Dow.

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The metallocene process, and particularly the catalysts and catalyst support systems are the subject of a number of patents. U.S. Patent 4,542,199 to Kaminsky et al. describes a procedure wherein MAO is added to toluene, the metallocene catalyst of the general formula (cyclopentadienyl)2MeRHal wherein Me is a transition metal, Hal is a halogen and R is cyclopentadienyl or a C1 to C6 alkyl radical or a halogen, is added, and ethylene is then added to form polyethylene. U.S. Patent 5,189,192 to LaPointe et al. and assigned to Dow Chemical describes a process for preparing addition polymerization catalysts via metal center oxidation. U.S. Patent 5,352,749 to Exxon Chemical Patents, Inc. describes a method for polymerizing monomers in fluidized beds. U.S. Patent 5,349,100 describes chiral metallocene compounds and preparation thereof by creation of a chiral center by enantioselective hydride transfer.

Co-catalysts are materials such as methylaluminoxane (MAO) which is the most common, other alkylaluminums and boron containing compounds like tris(pentafluorophenyl)boron, lithium tetrakis(pentafluorophenyl)boron, and dimethylanilinium tetrakis(pentafluorophenyl)boron. Research is continuing on other co-catalyst systems or the possibility of minimizing or even eliminating the alkylaluminums because of handling and product contamination issues. The important point is that the metallocene catalyst be activated or ionized to a cationic form for reaction with the monomer(s) to be polymerized.

The metallocene-catalyzed ethylene-based polymers used in the present invention impart stretch and recovery properties to the film. Preferably, the metallocene catalyzed ethylene-based polymer is selected from copolymers of ethylene and 1-butene, copolymers of ethylene and 1-hexene, copolymers of ethylene and 1-octene and combinations thereof. In particular, preferred materials include AffinityJ brand elastomeric metallocene-derived copolymers of ethylene and 1-octene, both available from Dow Plastics of Freeport, Texas. Particularly preferred materials also include ExactJ brand elastomer metallocene-derived copolymers and terpolymers of ethylene and 1-butene and copolymers of ethylene and 1-hexene,

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available from Exxon Chemical Company of Houston, Texas.

Another useful polyolefin resin of the present invention include flexible polyolefins, which have a propylene-based polymer having atactic polypropylene units in the polymer

5 chain. For example, the propylene-based polymer may be isotactic polypropylene with atactic groups incorporated within the main polymer chain to break up the crystallinity. Alternatively, it could be an "in-situ" blend of atactic and isotactic polypropylene. Preferably, the propylene-based 10 polymer has a low crystallinity, such as from about 10-30% crystallinity measured by differential scanning calorimetry (wherein the crystallinity of pure polypropylene is used as the standard). Suitable examples of FPO include RexFlex™ FPO polymers available from Rexene Corporation of Dallas, Texas.

15 RexFlex™ FPOs include homopolymers as well as copolymer wherein the comonomer is ethylene. Specific examples of RexFlex™ FPOs include homopolymer grades D100, D2300, D1700, D1710 and D1720 as well as copolymer grades D400, D1800, D1810 and D1820.

20 The microporous elastic film of the present invention can be prepared by (a) forming a mixture of an elastic resin and a solvent that permits solid (crystalline)-liquid separation; (b) heating the mixture to an elevated temperature to produce a solution of polyolefin and solvent; (c) forming a precursor 25 film from the solution; (d) cooling the precursor film at a temperature at which the solvent separates from the polyolefin by phase separation to form a gel film; (e) separating the solvent from the gel film to form a microporous film; and (f) drying the microporous film.

30 In step (a) of this invention, the melt blend may include between about 5 and about 50 weight percent of elastic polyolefin based upon the weight of the blend. Suitable examples of solvents include decalin, dioctylphthalate, mineral oil, hexatriacontane, octadecane, hexadecane and 35 dodecane. Optionally, conventional or non-conventional additives also can be added to the mixture of step (a), so long as they do not take away from the advantages provided by

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the present invention. These additives include, for example, fillers, processing aids, anti-oxidants, stabilizers, pigments, etc.

5 The temperature of step (b) depends upon the melting temperature of the polyolefin and the boiling temperature of the solvent. Generally, the temperature is between about 50 and about 200°C.

10 The precursor film of step (c) can be formed through, for example, extrusion of the melt blend through a die.

15 The cooling temperature of step (d) is below the phase separation temperature. Typically, temperatures of below 100°C. have been employed. The cooling rate of the precursor film can affect the microporous structure produced. In general, slower cooling rates tend to provide larger pores in the film and increased gas and liquid permeability. The length of time the precursor film is maintained under cooling conditions also affect the ultimate microporous structure and properties of the microporous film produced.

20 The separation process of step (e) is generally carried out with extraction. Extraction can be achieved by immersing the precursor film in a bath of suitable extractant liquid, such as hot ethanol or hexane. Another suitable method of separation is sublimation using, for example, naphthalene.

25 It is preferred to secure the film during the solvent separation process, since the film generally shrinks during solvent removal. Securing the film would minimize dimensional change in the film as well as minimize collapse of the microporous structure.

30 The drying process of step (f) is carried out to remove any remaining extractant. Drying may be performed at ambient temperature or at elevated temperatures of, for example, up to 130 °C. The microporous film may be strengthened if the drying process is done at elevated temperatures. It is preferred to secure the film during the drying process in order to minimize dimensional changes and/or collapse of the microporous structure.

35 Suitable processes of extruding, separating and drying the microporous film of the present invention are described in

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the previously described patents assigned to Millipore Corporation, U.S. Patent Nos. 4,778,601; 4,828,772; 4,874,567; 4,902,456; 4,906,377; 4,990,294; and 5,032,274, all of which are incorporated herein by reference in their entirety.

Oftentimes it may be desirable to laminate a film of the present invention to one or more substrates or support layers. Lamination of film may enhance the strength and thus durability of the film. If desired, filled film 10 may be attached to one or more support layers 30 to form a laminate 32. Referring to Figure 1, a conventional fibrous nonwoven web forming apparatus 48, such as a pair of spunbond machines, is used to form the support layer 30. The long, essentially continuous fibers 50 are deposited onto a forming wire 52 as an unbonded web 54 and the unbonded web 54 is then sent through a pair of bonding rolls 56 to bond the fibers together and increase the tear strength of the resultant web support layer 30. One or both of the rolls are often heated to aid in bonding. Typically, one of the rolls 56 is also patterned so as to impart a discrete bond pattern with a prescribed bond surface area to the web 30. The other roll is usually a smooth anvil roll but this roll also may be patterned if so desired. Once filled film 10 has been sufficiently stretched and the support layer 30 has been formed, the two layers are brought together and laminated to one another using a pair of laminating rolls or other means 58. As with the bonding rolls 56, the laminating rolls 58 may be heated. Also, at least one of the rolls may be patterned to create a discrete bond pattern with a prescribed bond surface area for the resultant laminate 32. Generally, the maximum bond point surface area for a given area of surface on one side of the laminate 32 will not exceed about 50 percent of the total surface area. There are a number of discrete bond patterns which may be used. See, for example, Brock et al., U.S. Patent Number 4,041,203 which is incorporated herein by reference in its entirety. Once the laminate 32 exists the laminating rolls 58, it may be wound up into a roll 60 for subsequent processing. Alternatively, the laminate 32 may continue in-

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line for further processing or conversion.

While the support layers 30 and film 10 shown in Figure 1 were bonded together through thermal point bonding, other bonding means can also be used. Suitable alternatives

5 include, for example, adhesive bonding and the use of tackifiers. In adhesive bonding, an adhesive such as a hot melt adhesive is applied between the film and fiber to bind the film and fiber together. The adhesive can be applied by, for example, melt spraying, printing or meltblowing. Various 10 types of adhesives are available, including those produced from amorphous polyalphaolefins, ethylene vinyl acetate-based hot melts, and Kraton® brand adhesives available from Shell Chemical of Houston, Texas and Rextac® Brand Adhesives from Rexene of Odessa, Texas.

15 When the film and support layer(s) is bonded with tackifiers, the tackifier may be incorporated into the film itself. The tackifier essentially serves to increase adhesion between the film and fiber layers. The film and fiber laminate may subsequently be thermally point-bonded, although 20 generally very little heat is required since the tackifier tends to increase the pressure sensitivity of the film and a bond somewhat like an adhesive bond can be formed. Examples of useful tackifiers include Wingtack™ 95, available from Goodyear Tire & Rubber Co. of Akron, Ohio, and Escorez™ 5300, 25 available from Exxon Chemical Company of Houston, Texas.

The direction of elasticity in the laminate may be tailored by the state of the film, i.e., whether it is relaxed or stretched, during the bonding with the support layer, as well as the physical property of the support layer material.

30 For example, if the film is still stretched while bonding to the nonwoven and the support layer is extensible in the cross-machine direction ("CD"), then a laminate with both CD and machine-direction ("MD") stretch can be produced. If the film is bonded to a non CD-extensible support layer while in a 35 stretched state, then a laminate with a MD only stretch can be produced.

The support layers 30 as shown in Figure 2 are fibrous

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nonwoven webs. The manufacture of such fibrous nonwoven webs is known. Such fibrous nonwoven webs can add additional properties to filled film 10, such as a more soft, cloth-like feel. This is particularly advantageous when filled film 10 5 is being used as a barrier layer to liquids in such applications as outer covers for personal care absorbent articles and as barrier materials for hospital, surgical, and clean room applications such as, for example, surgical drapes, gowns and other forms of apparel. Attachment of the support 10 layers 30 to the filled film 10 may be by the use of a separate adhesive such as hot-melt and solvent based adhesives or through the use of heat and/or pressure (also known as thermal bonding) as with heated bonding rolls.

The support layer in a laminate containing the film layer 15 of the present invention can be necked polypropylene spunbond, crimped polypropylene spunbond, bonded carded webs, elastomeric spunbond or meltblown fabrics produced from elastomeric resins. A particularly advantageous support layer is a fibrous nonwoven web. Such webs may be formed from a 20 number of processes including, but not limited to, spunbonding, meltblowing and bonded carded web processes. Meltblown fibers are formed by extruding molten thermoplastic material through a plurality of fine, usually circular, 25 capillaries as molten threads or filaments into a high velocity usually heated gas stream such as air, which attenuates the filaments of molten thermoplastic material to reduce their diameters. Thereafter, the meltblown fibers are carried by the high velocity usually heated gas stream and are deposited on a collecting surface to form a web of randomly 30 dispersed meltblown fibers. The meltblown process is well-known and is described in various patents and publications, including NRL Report 4364, "Manufacture of Super-Fine Organic Fibers" by B. A. Wendt, E. L. Boone and D. D. Fluharty; NRL Report 5265, "An Improved Device For The Formation of Super-Fine Thermoplastic Fibers" by K. D. Lawrence, R. T. Lukas, J. 35 A. Young; U.S. Patent Number 3,676,242, issued July 11, 1972, to Prentice; and U.S. Patent Number 3,849,241, issued November 19, 1974, to Buntin, et al. The foregoing references are

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incorporated herein by reference in their entirety.

Spunbond fibers are formed by extruding a molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries in a spinnerette with the 5 diameter of the extruded filaments then being rapidly reduced, for example, by non-educative or educative fluid-drawing or other well-known spunbonding mechanisms. The production of spunbond nonwoven webs is illustrated in patents such as Appel et al., U.S. Patent Number 4,340,563; Matsuki, et al., U.S. 10 Patent Number 3,802,817; Dorschner et al., U.S. Patent 3,692,618; Kinney, U.S. Patent Numbers 3,338,992 and 3,341,394; Levy, U.S. Patent Number 3,276,944; Peterson, U.S. Patent Number 3,502,538; Hartman, U.S. Patent Number 3,502,763; Dobo et al., U.S. Patent Number 3,542,615; and 15 Harmon, Canadian Patent Number 803,714. All of the foregoing references are incorporated herein by reference in their entirety.

A plurality of support layers 30 also may be used. Examples of such materials can include, for example, 20 spunbond/meltblown laminates and spunbond/meltblown/spunbond laminates such as are taught in Brock et al., U.S. Patent Number 4,041,203 which is incorporated herein by reference in its entirety.

Bonded carded webs are made from staple fibers which are 25 usually purchased in bales. The bales are placed in a picker which separates the fibers. Next the fibers are sent through a combing or carding unit which further breaks apart and aligns the staple fibers in the machine direction so as to form a machine direction-oriented fibrous nonwoven web. Once 30 the web has been formed, it is then bonded by one or more of several bonding methods. One bonding method is powder bonding wherein a powdered adhesive is distributed throughout the web and then activated, usually by heating the web and adhesive with hot air. Another bonding method is pattern bonding 35 wherein heated calendar rolls or ultrasonic bonding equipment is used to bond the fibers together, usually in a localized bond pattern though the web can be bonded across its entire surface if so desired. When using bicomponent staple fibers,

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through-air bonding equipment is, for many applications, especially advantageous.

The process shown in Figure 1 also may be used to create a three layer laminate. The only modification to the 5 previously described process is to feed a supply 62 of a second fibrous nonwoven web support layer 30a into the laminating rolls 58 on a side of filled film 10 opposite that of the other fibrous nonwoven web support layer 30. As shown in Figure 1, one or both of the support layers may be formed 10 directly in-line, as is support layer 30. Alternatively, the supply of one or both support layers may be in the form of a pre-formed roll 62, as is support layer 30a. In either event, the second support layer 30a is fed into the laminating rolls 58 and is laminated to filled film 10 in the same fashion as 15 the first support layer 30.

As has been stated previously, filled film 10 and the breathable laminate 32 may be used in a wide variety of applications not the least of which includes limited use products such as personal care absorbent articles including 20 diapers, training pants, incontinence devices and feminine hygiene products such as sanitary napkins. Other uses for the filled film and breathable film/support layer laminates according to the present invention include, but are not 25 limited to, surgical drapes and gowns, wipers, barrier materials and articles of clothing or portions thereof including such items as workwear and lab coats.

Of course, it should be understood that a wide range of changes and modifications can be made to the embodiments described above. It is therefore intended that the foregoing 30 description illustrates rather than limits this invention, and that it is the following claims, including all equivalents, which define this invention.

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CLAIMS:

1. A method for producing a laminate comprising the steps of:

5 (a) forming a mixture of an elastic resin and a solvent that permits polyolefin-liquid separation, said melt blend containing between about 5 and about 50 weight percent of elastic polyolefin based upon the weight of the blend;

10 (b) heating said mixture to an elevated temperature to produce a solution of polyolefin and solvent;

10 (c) forming a precursor film from said solution;

15 (d) cooling said precursor film at a temperature at which said solvent separates from said polyolefin by phase separation to form a gel film;

(e) separating said solvent from said gel film to form a microporous film;

(f) drying said microporous film;

(g) bonding at least one support layer to said microporous film.

20 2. The process of claim 110 wherein said elastic polyolefin is selected from polyethylene elastomers, polypropylenes with atactic groups in the polymer chain and combinations thereof.

25 3. The process of claim 110 wherein said elastic polyolefin includes metallocene-catalyzed ethylene-based elastomers.

4. The process of claim 1 wherein said precursor film of step (c) is formed by casting or blowing.

30 5. The process of claim 1 wherein said solvent selected from decalin, dioctylphthalate, mineral oil, hexatriacontane, octadecane, hexadecane and dodecane.

35 6. The process of claim 1 wherein said support layer is bonded to said film with an adhesive.

7. The process of claim 1 wherein said support layer is thermally bonded to said film.

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8.. A laminate formed by the process of claim 1.

9. A medical garment comprising:

5 a microporous film formed from the process including the steps of (a) forming a mixture of an elastic resin and a solvent that permits polyolefin-liquid separation, said melt blend containing between about 5 and about 50 weight percent of elastic polyolefin based upon the weight of the blend; 10 (b) heating said mixture to an elevated temperature to produce a solution of polyolefin and solvent; (c) forming a precursor film from said solution; (d) cooling said precursor film at a temperature at which said solvent separates from said polyolefin by phase separation to form a gel film; 15 (e) separating said solvent from said gel film to form a microporous film; (f) drying said microporous film; at least one support layer bonded to said film.

10. A limited use product comprising:

20 a microporous film formed from the process including the steps of (a) forming a mixture of an elastic resin and a solvent that permits polyolefin-liquid separation, said melt blend containing between about 5 and about 50 weight percent of elastic polyolefin based upon the weight of the blend; 25 (b) heating said mixture to an elevated temperature to produce a solution of polyolefin and solvent; (c) forming a precursor film from said solution; (d) cooling said precursor film at a temperature at which said solvent separates from said polyolefin by phase separation to form a gel film; 30 (e) separating said solvent from said gel film to form a microporous film; (f) drying said microporous film.

35 11. The process of claim 10 wherein said elastic polyolefin is selected from polyethylene elastomers, polypropylenes with atactic groups in the polymer chain and combinations thereof.

12. The process of claim 10 wherein said elastic polyolefin includes metallocene-catalyzed ethylene-based elastomers.

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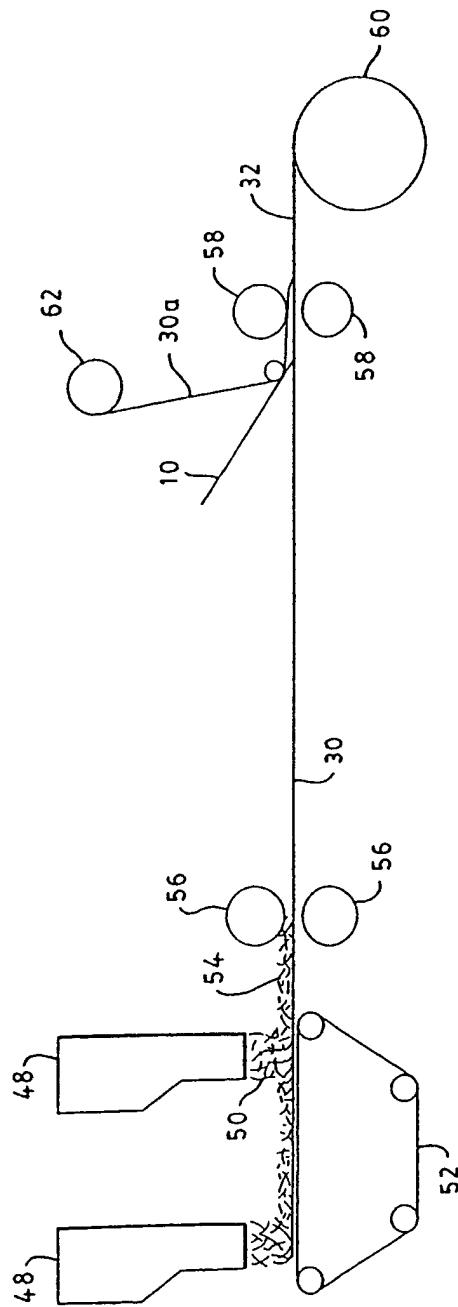


FIG. 1

# INTERNATIONAL SEARCH REPORT

Int. Application No  
PCT/US 97/23045

A. CLASSIFICATION OF SUBJECT MATTER IPC 6 B32B27/32 C08J9/28 C08J5/18 A61L15/22		
According to International Patent Classification(IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 6 B32B C08J A61L		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category <sup>a</sup>	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 86 02282 A (MILLIPORE CORP) 24 April 1986 see the whole document & US 4 778 601 A cited in the application & US 4 828 772 A cited in the application ---	1-12
Y	WO 93 16863 A (EXXON CHEMICAL PATENTS INC) 2 September 1993 see the whole document ---	1-12
P, Y	WO 97 20091 A (KIMBERLY CLARK CO) 5 June 1997 see the whole document ---	1-12 -/-
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.		<input checked="" type="checkbox"/> Patent family members are listed in annex.
* Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		
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1 Date of the actual completion of the international search  30 March 1998		Date of mailing of the international search report  16/04/1998
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer  Tarrida Torrell, J

**INTERNATIONAL SEARCH REPORT**

Inte onal Application No  
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**C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT**

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